NSW Border Rivers valley annual surface water quality report: 2022–2023

Key Points

- Flow during July 2022 to June 2023 was characterised by heavy rain falling across much of the catchment in 2022, resulting in flooding in all waterways in the Border Rivers catchment. Lower rainfall in 2023 saw river heights drop to more normal levels.
- With flooding on this scale there was an increased risk of hypoxic blackwater events. There were no reports of fish deaths in the Border Rivers catchment caused by low dissolved oxygen.
- Flooding was the main driver of water quality in the Border Rivers. The water quality index indicated that of the 15 sites in the catchment, one was rated as good, 13 were rated as moderate and one as poor. Only one site (Beardy River) returned a lower water quality index score in 2022–2023 compared to 2021–2022.
- All sites were below the Basin Plan agriculture and irrigation salinity target of 957 µS/cm (microSiemens per centimetre). The median and 80th percentile at Mungindi were both above the End-of Valley targets of 281 µS/cm and 380 µS/cm respectively.
- Pindari Dam had a red alert warning for blue-green algae from December 2022 through until June 2023. Some algae appear to have been transferred to the Severn River immediately downstream of Pindari dam.

The water quality data used in this report is compiled from 15 routine water quality monitoring sites. The data is collected on a monthly frequency for 2 monitoring programs, with 10 sites collected under the Border Rivers water quality monitoring program on behalf of the Dumaresq-Barwon Rivers Commission and 5 sites for the State Water Quality Assessment and Monitoring Program. These programs are responsible for collecting, analysing and reporting the ambient water quality condition of rivers in NSW. This annual report summarises the surface water quality data collected in the Border Rivers Valley from July 2022 to June 2023. The location of monitoring sites is shown in Figure 1.

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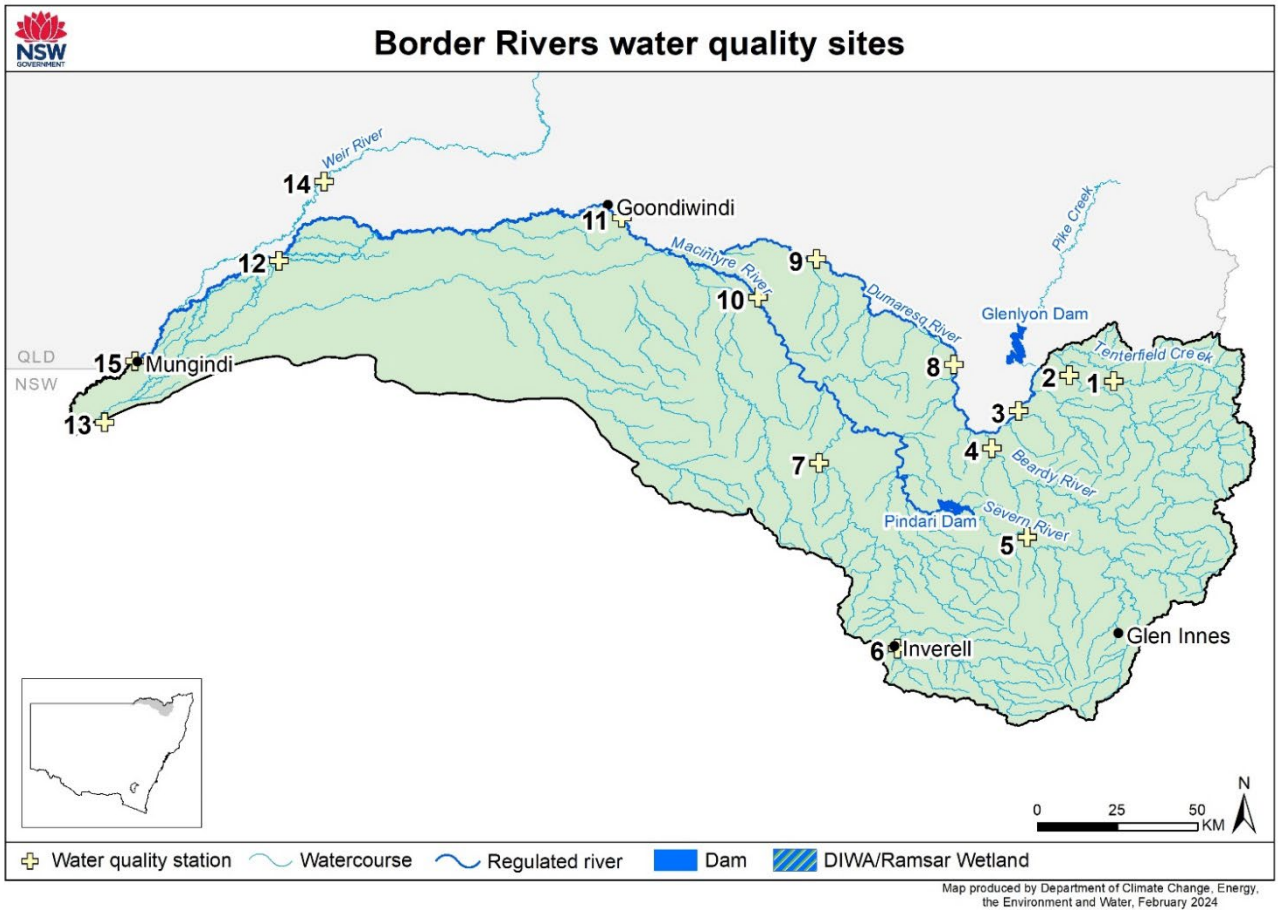

Figure 1: Location of routine water quality monitoring sites in the Border Rivers valley

Table 1: Site information for each monitoring site in the Border Rivers catchment. Refer to Figure 1 and site numbers for location of each site.

Site number	Site name	Water Quality Zone	Station number
1	Tenterfield Creek at Clifton	Unregulated Dumaresq uplands	416003
2	Mole River at Donaldson	Unregulated Dumaresq uplands	416032
3	Dumaresq River at Roseneath	Regulated Dumaresq uplands	416011
4	Beardy River at Haystack	Unregulated Dumaresq uplands	416008
5	Severn River at Strathbogie Road Bridge	Macintyre Montane	416039
6	Macintyre River at Inverell	Unregulated Macintyre River uplands	416016
7	Macintyre River at Wallangra	Unregulated Macintyre River uplands	416010
8	Dumaresq River at Bonshaw Weir	Regulated Dumaresq uplands	416007
9	Dumaresq River at Glenarbon Weir	Regulated Dumaresq uplands	416040
10	Macintyre River at Holdfast Crossing	Regulated Macintyre uplands	416012
11	Macintyre River at Salisbury Bridge	Regulated Macintyre uplands	41610044
12	Macintyre River at Kanowna	Border Rivers lowlands	416048
13	Gil Gil Creek at Collarenebri Road Bridge	Border Rivers lowlands	41610152
14	Weir River at Tallwood	Border Rivers lowlands	416202A
15	Barwon River at Mungindi	Border Rivers lowlands	416001

Catchment description

The Border Rivers Catchment is located on the NSW/Queensland border, with an area of 24,000 km^2. The NSW portion of the Border Rivers rises in the hilly and rugged granite and basalt areas of the New England Tablelands to an elevation of 1,300 m above sea level. The catchment is bounded by the Gwydir Catchment to the south and the Great Dividing Range to the east and the Queensland border to the north.

The Border Rivers catchment consists of several major upland tributaries and flows westward onto a flat plain with numerous channels. In the north-east, the Macintyre River rises in the Waterloo Range and is 300 km in length. The Severn River (NSW) is a major tributary of the Macintyre River and flows into Pindari Dam. Immediately to the north and flowing into the Macintyre River is the Dumaresq River. The Dumaresq River is 214 km in length and is formed by the joining of the Severn River that rises in Queensland, and Tenterfield Creek which rises in the New England Tablelands west of Tenterfield. Other tributaries are Pike Creek (Queensland), which flows into Glenlyon Dam, Mole River and Beardy River. Pindari Dam (NSW) and Glenlyon Dam (QLD) are 2 of the major water storages influencing the catchment.

Land use in the NSW Border Rivers catchment is largely grazing in the upper catchment, with increased cultivation in the mid and lower sections. Irrigated agriculture is mostly located adjacent to the Macintyre River downstream from Boggabilla.

Catchment conditions during 2022–2023

Flow during 2022–2023 was characterised by heavy rain falling across the catchment in September and October (Figure 2A). This rainfall resulted in significant inflows maintaining Pindari Dam at and Glenlyon Dam above 100% capacity through 2022 (Figure 2B). Releases from both dams saw a drop in capacity in early 2023. Figure 2C highlights that regular flooding was a feature in all waterways in the Border Rivers in 2022 with flows decreasing in 2023. In early November discharge in the Dumaresq River at Glenarbon Weir peaked at 41,224 megalitres per day (ML/day), while at the end of October the Macintyre River at Holdfast Crossing peaked at over 103,230 ML/day. As the flows from these two systems spread out across the lower Macintyre River valley, the flood peak decreased resulting in a maximum discharge of over 34,016 ML/day in the Barwon River at Mungindi in early November, but the flooding was extended over a longer period (Figure 2C).

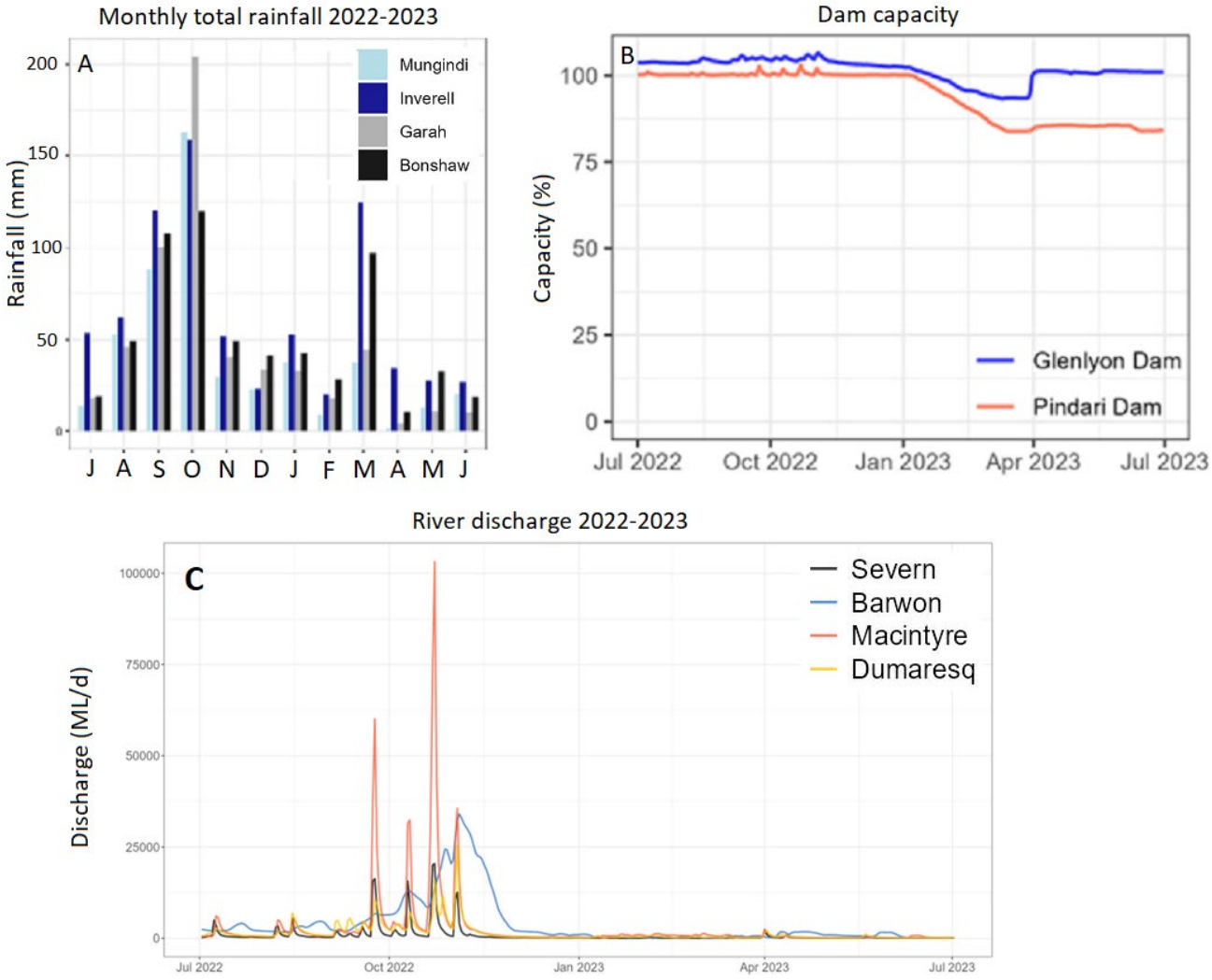

Figure 2: Catchment conditions for selected stations in the Border Rivers catchments from July 2022 to June 2023 for A: Monthly total rainfall (mm) B: Dam capacity (%) and C: River discharge (ML/day).

Water quality for water dependent ecosystems

NSW uses a Water Quality Index (WaQI) as a tool to communicate complex and technical water quality data in a simple and consistent way. The WaQI score is calculated for each monitoring site using total nitrogen, total phosphorus, turbidity, pH, dissolved oxygen and electrical conductivity. The index compares the monthly water quality results against a set of predetermined water quality targets to calculate a score between 1 and 100. A score of 100 represents a site in pristine condition, while a score of one is a very highly degraded site. This value can then be categorised to rate the general water quality at a monitoring site. The results from the WaQI are summarised in Figure 3.

Sites where there has been a change of less than 5 points in WaQI score, have been identified with horizontal arrows. Arrows pointing up or down indicate the score has increased/decreased by more than 5 points.

Compared to the 2021–2022 results, the water quality index category ratings in the Border Rivers improved in 2022–2023 for 2 of the 15 sites, one site had a decline in rating, while the ratings remained the same for the other 12 sites.

- Dumaresq River at Bonshaw weir improved from poor to moderate.
- Barwon River at Mungindi improved from moderate to good.
- Beardy River at Haystack declined from good to moderate.
- Weir River at Tallwood remained poor.

The Weir River at Tallwood was the only site in the Border Rivers catchment rated as poor. The index score in the Weir River was low due to high readings for turbidity, total nitrogen and total phosphorus concentrations caused by high flow. The Barwon River at Mungindi was rated as good, with all other Border Rivers sites rated as moderate.

The index score at 8 of the 15 sites showed minimal change. Only one site (Beardy River at Haystack) returned a lower score, largely in response to an increase in electrical conductivity, and dissolved oxygen results above the desired range for aquatic ecosystems.

The remaining 6 sites returned a better index score than in 2021 to 2022, most likely in response to less extensive flooding than was experienced in 2022–2023.

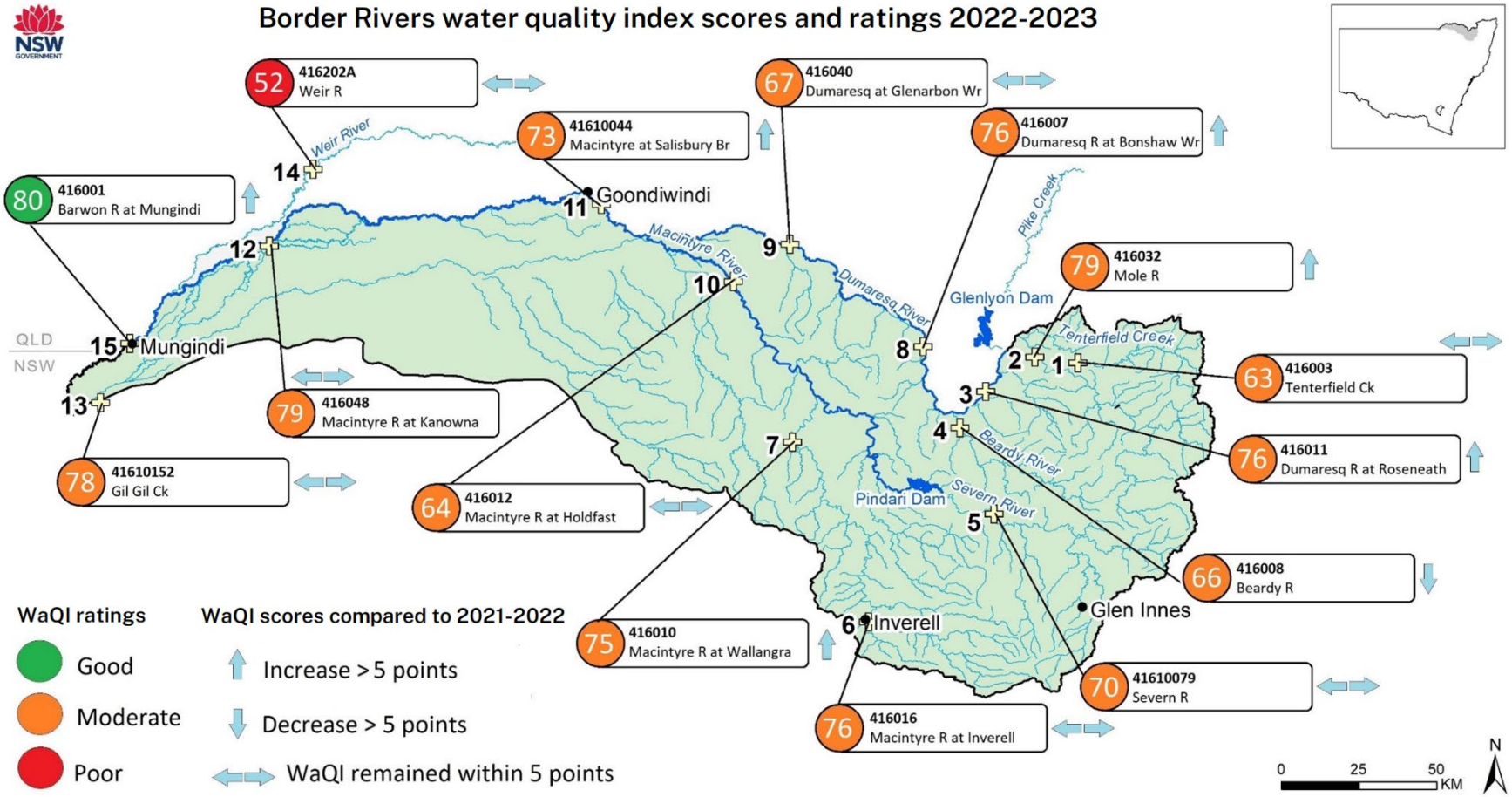

Figure 3: Water quality index scores and ratings for the NSW Border Rivers valley

The median pH in the Border Rivers was above 7.0 at all sites and suitable for aquatic ecosystem health or agricultural enterprises.

There was a gradual increase in turbidity and total suspended solids with distance down the catchment until Salisbury Bridge (near Goondiwindi), with a larger increase at sites in the lower valley. This reflects the impact of the cumulative effects of land use, soil disturbance and human activity on water quality. The highest turbidity results were in the Weir River, followed by Gil Gil Creek at Collarenebri Road Bridge, Macintyre River at Kanowna and the Barwon River at Mungindi.

The highest phosphorus concentrations in the upland areas of the Border Rivers were in the Macintyre catchment at Inverell and Wallangra and the Severn River, while the lower results were in the unregulated tributaries such as the Mole and Beardy Rivers and the regulated Dumaresq River (Roseneath, Bonshaw and Glenarbon). Most of the uplands area has low soil nutrient concentrations, though there is an area of basalt-derived soils along the Great Dividing Range near Glen Innes and Inverell with higher soil nitrogen and phosphorus, which contributes to the high nutrient concentrations found in the Macintyre and Severn Rivers. Soil erosion and nutrient transport can be exacerbated by the historical conversion of forested land to grazing, particularly clearing in the riparian zone.

The fertile soils associated with cropping and irrigation in the lowland area of the Border Rivers are a source of excess nutrients in Gil Gil Creek, Weir River and Barwon River at Mungindi. Extended flooding would have mobilised large volumes of sediment and attached nutrients across the Border Rivers catchment.

Dissolved oxygen levels were relatively consistent at all sites except for the Weir River. Flooding would have flushed organic matter off the lowland floodplains and into waterways. The rapid breakdown of this material by bacteria can cause dissolved oxygen levels to decline. Flooding over previous years may have already removed some of the organic material from the floodplain resulting in less impact on dissolved oxygen levels. The lowest dissolved oxygen readings are usually in the lower catchment, where high turbidity reduces light penetration, reducing aquatic plant growth and higher water temperature reduces the solubility of oxygen in the water column.

The three sites in the Macintyre catchment (Inverell, Wallangra and Holdfast Crossing) had the highest median electrical conductivity. There is a large salt store in the geology and soils in parts of the upper Macintyre catchments. These salts would have been mobilised following the heavy rainfall during 2022 and recharge of shallow groundwater. Less saline water from the Severn River provides dilution flows in the Macintyre River resulting in a drop in electrical conductivity between the Wallangra and Holdfast Crossing monitoring sites. Due to the regular rainfall and high flows,

electrical conductivity results were generally low across the catchment and there was no risk to agriculture production or soil structure decline.

Summary statistics for the key water quality parameters at each monitoring site in the Border Rivers catchment have been displayed as box plots (Figure 4). The box plots show the annual 25th, 50th and 75th percentile values, with error bars indicating the 10th and 90th percentile values for each site.

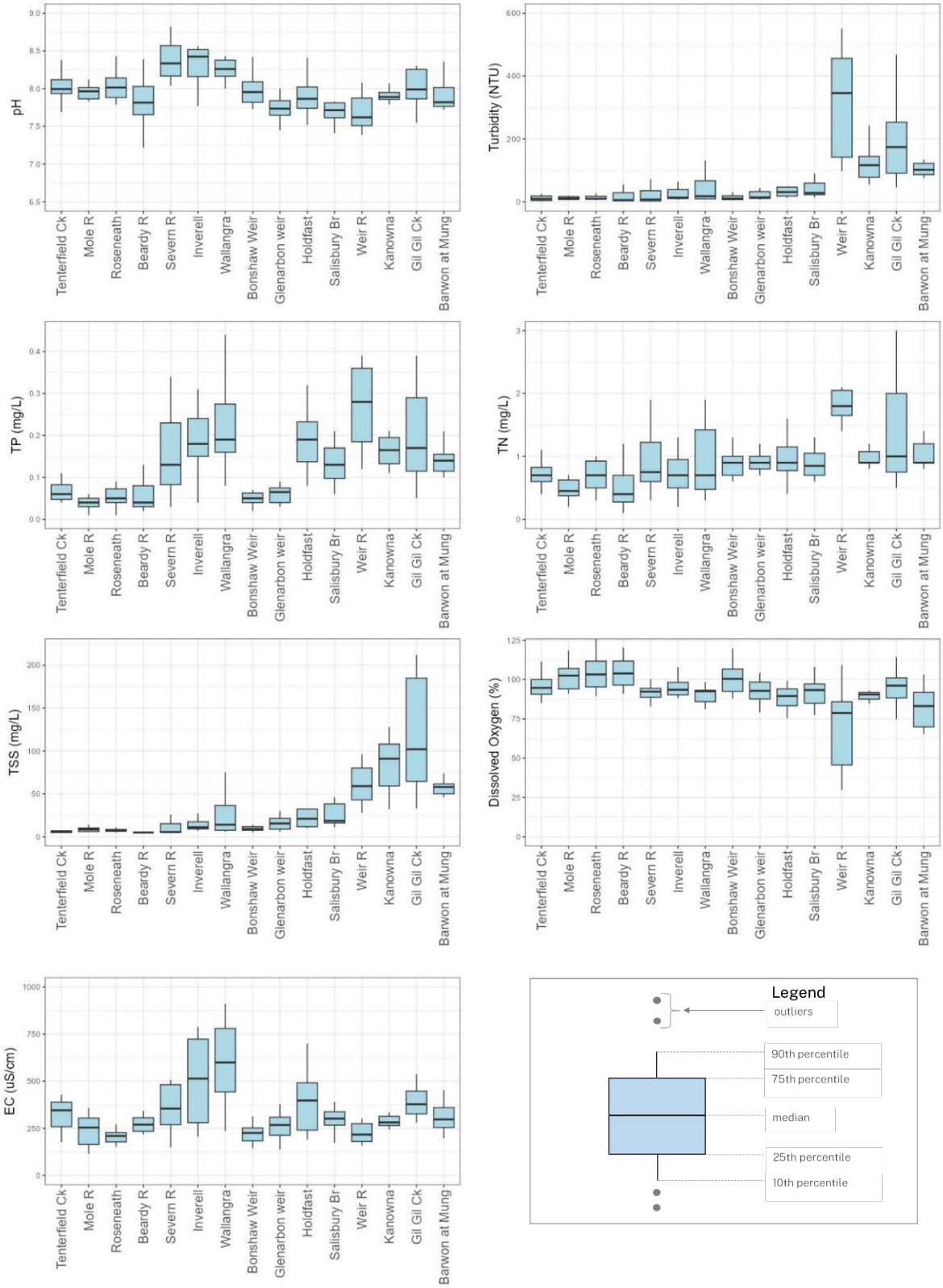

Figure 4: Water quality data by site, moving upstream to downstream from left to right. The water quality parameters shown are pH, Turbidity, Total phosphorus (TP), Total nitrogen (TN), Total suspended solids (TSS), Dissolved oxygen, and electrical conductivity (EC).

Irrigation and salinity

There are 4 continuous electrical conductivity monitoring sites in the Border Rivers catchment (Dumaresq River at Glenarbon Weir, Macintyre River at Inverell, Holdfast Crossing and Mungindi). Figure 5 shows electrical conductivity in the Macintyre River at Inverell was higher than in the other 3 sites but decreased quickly following dilution by heavy rainfall. All sites were below the Basin Plan agriculture and irrigation salinity target of 957 µS/cm for 2022 to 2023.

The Basin Salinity Management Strategy End-of-Valley salinity targets for the Barwon River at Mungindi are:

- the median percentile electrical conductivity does not exceed 250 µS/cm
- the 80th percentile electrical conductivity does not exceed 330 µS/cm and
- the annual salt load does not exceed 50,000 t/year.

The median of 281 µS/cm and 80th percentile of 380 µS/cm were both above the End-of-Valley target values. Due to the very high flows during 2022–2023 the annual salt load of 126,356 t/year greatly exceeded the End-of-Valley target.

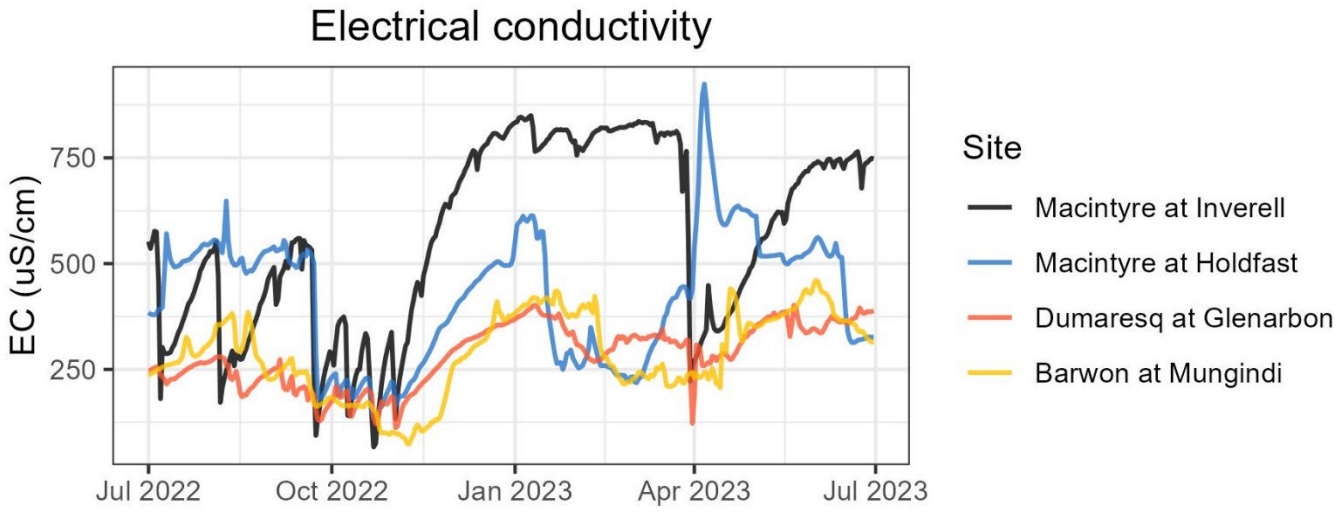

Figure 5: Electrical conductivity (µS/cm) in the Border Rivers valley

Recreation

Exposure to blue-green algae (cyanobacteria) through ingestion, inhalation or contact during recreational use of water can impact human health. A colour alert scale is used with a green alert warning indicating low numbers of blue-green algae but requiring monitoring, an amber alert warning being a heightened level of alert with increased sampling and surveillance, and a red alert

warning being a state of action where waters are unsuitable for recreational use. For more information about blue-green algae and algal alerts see the WaterNSW algae web page (Algae - WaterNSW).

Table 2 indicates the distribution of algal alerts from July 2022 to June 2023. Pindari Dam is known to have regular algal blooms, especially in summer. Red alerts for blue-green algal blooms have remained in some cases for months. Pindari Dam was on red alert for recreational use for almost 6 months starting in December until June. Inflow from the heavy rainfall events would also have flushed nutrients such as nitrogen and phosphorus into the dam which has encouraged algal growth. Pindari Dam has a multi-level offtake installed. During algal blooms, the offtake is set at a lower depth, to minimise the release of blue-green algae from the water surface of the storage into the Severn River downstream. This provides safe water for the village of Ashford and downstream water users.

Table 2: Distribution of algal alert levels in Pindari Dam July 2022 to June 2023

	Jul					Aug					Sep					Oct					Nov					Dec					Jan					Feb					Mar					Apr					May					Jun				
Pindari Dam	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	1	*	*	*	*	*	*	*	*	*	2	2	2	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3	3	3	3	2	2	3	3
Pindari Downstream (Severn River)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	*	*	*	*	2	2	2	*	*	1	1	1	1	2	2	2	2	1	1	2	2	1	1	1	1	1	1	1

Key : * = Nil/Low alert 1 = green alert 2 = amber alert 3 = red alert

Extreme water quality events

Spring 2022 was the wettest spring on record (since 1900) for New South Wales. In October, heavy rainfall led to widespread flooding in the Murray–Darling Basin, impacting many towns in inland New South Wales (Figure 6 - BoM, 2023).

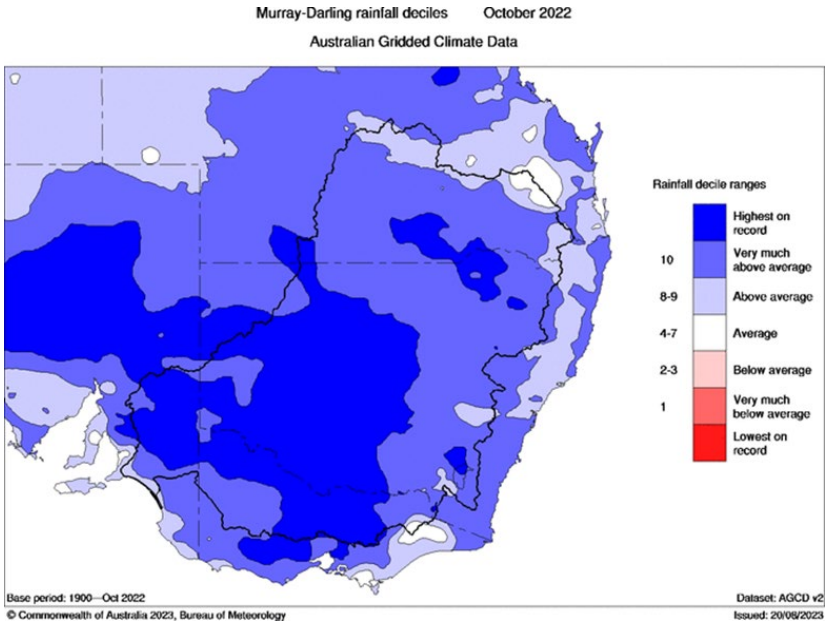

Figure 6: Murray Darling rainfall deciles for October 2022 (Source: BoM).

Heavy rainfall led to flooding in the Border Rivers catchment in late 2022. With flooding comes an increased risk of hypoxic blackwater events, caused by the rapid breakdown of organic matter by bacteria when it is inundated by floodwater. Flooding in the Border Rivers inundated the floodplain and would have washed organic material into creeks and waterways, however lower oxygen levels were not recorded, and no mass fish deaths were reported. As the flooding in 2022–2023 was less extensive than in 2021–2022, the floodwaters would have inundated areas that had already been recently flooded. With less time for organic matter to build up, there was minimal impact on dissolved oxygen levels.

Summary

The quality of the water in a river or stream reflects underlying climate and geology and the multiple activities and land uses occurring in a catchment area. Numerous factors can contribute to the observed results.

In 2022 to 2023, major flooding across the catchment was the key driver of water quality. Increased runoff carries high volumes of sediment and attached nutrients into waterways resulting in 13 of 15 water quality monitoring sites being rated as moderate, and one as poor. The high flows maintained electrical conductivity below the irrigation targets. However high rainfall and the recharge of shallow saline groundwater may lead to higher electrical conductivity in some catchments in future years as salts are mobilised from naturally saline soils and geology across the landscape.

The widespread flooding in the Border Rivers did not result in any fish deaths from hypoxic blackwater, as was experienced in some other catchments across NSW. The flushing of nutrients into Pindari Dam by floodwaters may have contributed to the high potentially harmful blue-green algal numbers from December to June 2023.

For more detailed information about water quality issues in the Border catchment see the Border surface water quality technical report (https://www.industry.nsw.gov.au/__data/assets/pdf_file/0007/305755/Water-quality-technical-report-for-the-Border-Rivers-surface-water-resource-plan-area-SW16.pdf).

Long-term water quality trends

Analysis of WaQI scores from 2012-2013 to 2022-2023 shows the Weir River has consistently low scores with a median below 50, which is a rating of poor (Figure 7). Tenterfield Creek has the next lowest median score over the 10-year period. All other sites have a long term median WaQI rating of good or moderate with sites lower down the Macintyre River at Holdfast Crossing, Salisbury Bridge, Kanowna and Mungindi having the highest long-term ratings. The range of WaQI scores varies across sites. Some sites have a large spread of results, some more consistent, while others have outliers that could be in response to droughts, floods or other significant disturbance events occurring in the catchment area.

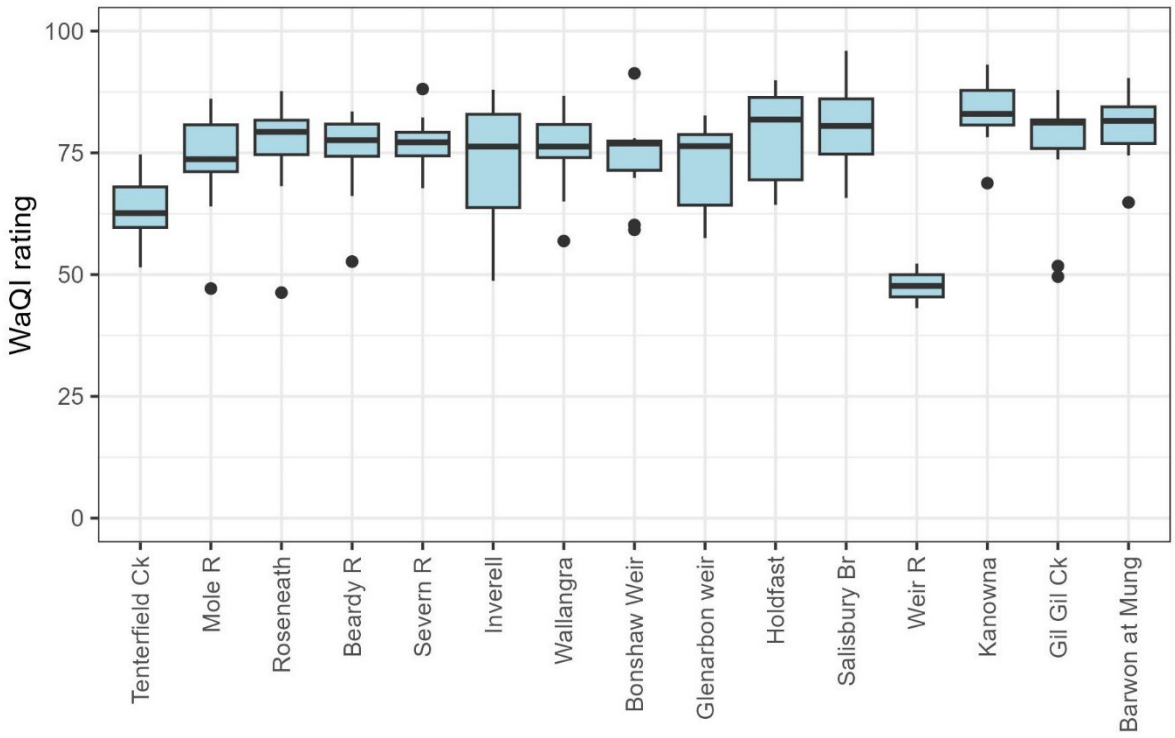

Figure 7: Boxplots showing long-term (2012-2013 to 2022-2023) WaQI ratings for every site in the NSW Border Rivers

The number of sites with ratings of good, moderate and poor fluctuated from year to year depending on the impacts of both droughts and floods (Figure 8). The number of sites with a good rating has declined, starting at 9 sites in 2012-2013 and declined to one site by 2022-2023. Moderate ratings have increased, peaking at 11 sites in 2021-2022 as the water quality at good sites declined. The number of poor sites has fluctuated between zero and 2 most years, apart from 2019-2020 which included both drought and flooding conditions and saw an increase to 8 sites.

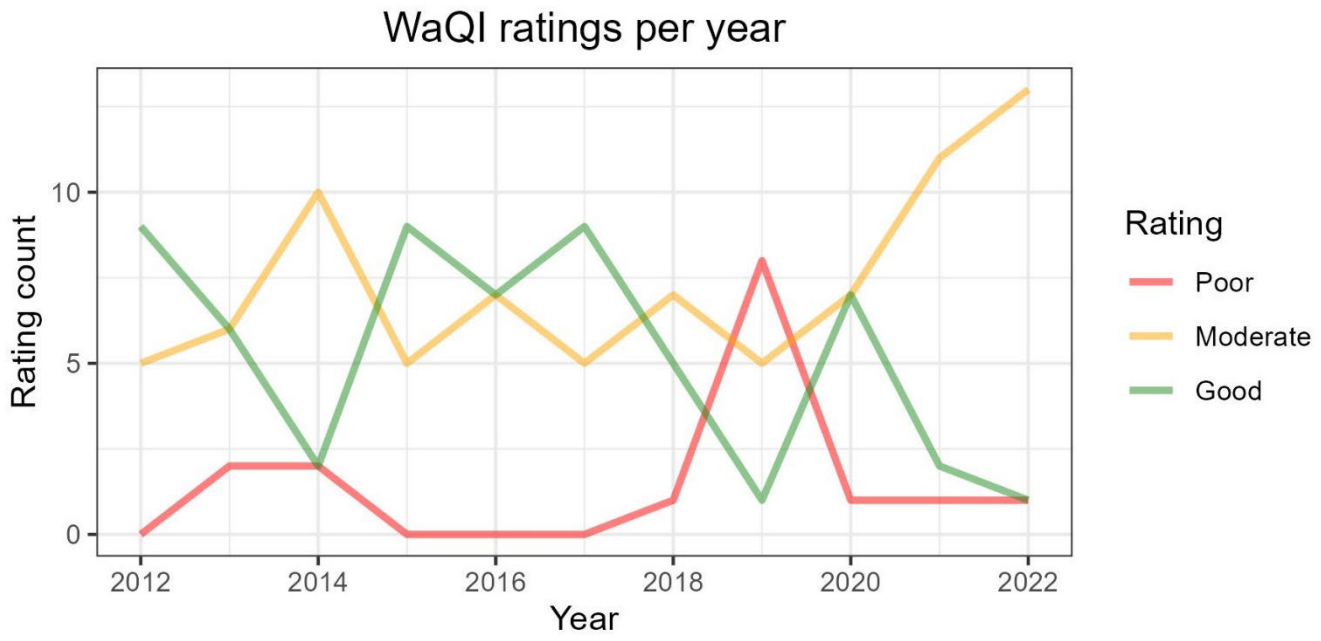

Figure 8: Graph summarising long-term water quality index ratings (2012–2013 to 2022–2023) for 15 sites in the NSW Border Rivers

References and further information

Bureau of Meteorology, (BoM). 2023. Financial year Australian climate and water statement 2023. Financial year climate and water report 2023. http://www.bom.gov.au/climate/current/financial-year/aus/summary.shtml#tabs=Water

Bureau of Meteorology, (BoM). Recent and historical rainfall maps: http://www.bom.gov.au/climate/maps/rainfall/?variable=rainfall&map=totals&period=daily&region=nat&year=2023&month=10&day=13

Fish kills in NSW: https://www.dpi.nsw.gov.au/fishing/habitat/threats/fish-kills

NSW DPE water for the environment: https://www.environment.nsw.gov.au/topics/water/water-for-the-environment/other-regions/border-rivers-annual-environmental-water-priorities

MDBA water management: https://www.mdba.gov.au/water-management/catchments/border-rivers